

QUARTERLY REPORT FORM

Report Date: February 2, 2005	U. S. DOE Project Director's Progress Report	Office of Science
Project Number: n/a	Title: U.S. LHC Construction Project	Program: High Energy Physics
Report Period: 1st Quarter FY2005	Project: U.S. CMS	Project Office: Fermi Site Office

SUMMARY ASSESSMENT

	<u>Current Quarter</u>	<u>Previous Quarter</u>
Cost:	Satisfactory	Satisfactory
Schedule:	Satisfactory	Satisfactory
Technical:	Satisfactory	Satisfactory
Overall:	Satisfactory	Satisfactory

PROJECT MANAGEMENT

DOE Program Manager:	Moishe Pripstein	Phone: (301) 903-4115
DOE Federal Project Director:	Pepin Carolan	Phone: (630) 840-2227
Contractor Project Manager:	Dan Green	Phone: (630) 840-3104

COST/FUNDING (\$K)

	<u>Baseline</u>	<u>Current Estimate</u>	<u>Funding Received</u>
DOE TPC:	147,050	147,050	135,986
NON DOE ¹ :	20,200	20,200	20,200
Total:	167,250	167,250	156,186

CRITICAL DECISIONS

<u>Number</u>	<u>Title</u>	<u>Baseline</u>	<u>Actual/Forecast</u>
CD-1	Approve Mission Need	12/97	12/97(A)
CD-2	Approve Baselines	12/98	12/98(A)
CD-3	Start Construction	12/97	12/97(A)
CD-4A	Project 97% Complete	09/05	09/05(F)
CD-4B ²	Project 100% Complete	09/08	09/08(F)

FUNDING PROFILE/COSTS

Per FY 2004 budget (\$M)

	<u>Prior</u>	<u>FY04</u>	<u>FY05</u>	<u>FY06</u>	<u>FY07</u>	<u>Total</u>
DOE TPC:	125.51	10.480	5.564	4.200	1.300	147.050
NON DOE:	20.2	0.000	0.000	0.000	0.000	20.200
TOTAL:	145.71	10.480	5.564	4.200	1.300	167.250

Cumulative through 12/31/04 (\$K)

Remaining Contingency:	9,080
Contingency/Remaining Costs ³ :	50%
Costs Accrued:	137,268
Open Commitments:	18,205

¹ National Science Foundation.

² US LHC Level 1 Baseline Change Proposal (USLHC BCP-001), established a two-phased CD-4 milestone. CD-4A = 97% complete. CD-4B remaining 3% of US commitments complete which are dependent upon the startup of the LHC. Funding profile is extended through FY07. No change in US LHC TPC.

³ Percentage Calculation: Remaining contingency divided by Remaining Work (Remaining Work = Estimate at Completion – Budgeted Cost of Work Performed).

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SCHEDULE SUMMARY

<u>Key US CMS Milestones Accomplished</u>	<u>Baseline Date</u>	<u>Actual Date</u>
• HG-002 – HCAL Front-end Electronics Production Complete	30-Jun-04	1-Dec-04
<u>Key US CMS Milestones Upcoming</u>	<u>Baseline Date</u>	<u>Forecast Date</u>
• QT-1305 – TRIG CSC: Muon Port Card Production Test Complete	31-Jan-05	31-Jan-05

NARRATIVE HIGHLIGHTS

As of December 31, 2004 the overall U.S. CMS construction project was 89% complete vs. the scheduled 91% complete. The project is performing well with respect to technical, cost and schedule. The endgame plan to complete the project in coordination with international CMS has been developed and appears reasonable. U.S. CMS is mitigating remaining project risk in Forward Pixels and Silicon Tracker by augmenting Pixel resources, further optimizing tracker production capability and working with CERN to increase parts flow. U.S. CMS had adopted the new CMS “v34.0” schedule for those milestones not yet accomplished, and milestone dates are updated to CMS v34 schedule status.

- Endcap Muon (EMU): Production of Cathode Strip Chambers (CSCs) at Fermilab is complete, and the Final Assembly and System Testing (FAST) sites have ended operations. Installation of the CSCs onto the CMS Endcap Yoke (YE) is proceeding well within the scheduled time. Production of off chamber electronics can begin following a successful 25 nsec test beam run.
- Hadron Calorimeter (HCAL): Front-end ASIC production is complete, and installation of the front-end electronics has begun. Vertical slice tests are expected to begin in SX5 early in CY05 following completion of the test beam run in October 2004.
- Trigger and Data Acquisition System (TriDAS): Trigger production is underway, and prototype modules will be used in the SX5 “slice test” and serve as a portable trigger. Work on the Data Acquisition (DAQ) Technical Design Report (TDR) is complete. The U.S. groups have changed responsibility for purchases so as to advance the U.S. schedule for DAQ.
- Electromagnetic Calorimeter (ECAL): The U.S. contribution to ECAL has been altered to conform to the new 1/4-micron ECAL electronics, with U.S. groups now involved also in the optical data links and low voltage supplies for ECAL, as well as the APDs and lasers for calibration. There was a successful test beam run of the new front end electronics in 2004.
- Forward Pixels (FPix): The first 1/4-micron version of the readout chip (ROC) has been received and tested, and a second prototype run has been received and declared to be of production quality. Since the U.S. CMS effort depends on ROC parts flow, this success bolsters the FPix schedule.
- Silicon Strip Tracker (SiTrk): Procurements of automation equipment at Fermilab and UC Santa Barbara are complete, and prototype modules, which exceed all specification, have been produced. All module components have entered production and production lines have doubled capacity; sensors will now be provided by Hamamatsu and a revised schedule has been made for SiTrk completion.
- Common Projects(CP): CP are very nearly complete except for field mapping the CMS magnet. This has slipped into FY05 in V34, so the milestone was revised to occur at the end of FY05.

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Left- A view of the H2 test beam at CERN during the 2004 vertical slice beam test. Components present included EMU, HCAL, RPC, trigger, and DAQ. The systems were successfully synchronized and read out in two different trigger modes with a common DAQ system. The successful beam test finished in October 2004.

Right- The CMS Fieldmapper nears completion at Fermilab. The fieldmapper is constructed of non-magnetic materials, and is designed to move under remote control in fixed steps in ΔZ and ΔR



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BACKUP INFORMATION

Baseline Documents

1. LHC International Agreement and the Accelerator and Experiments Protocols – approved Dec97 by DOE Secretary and NSF Director.
2. DOE/NSF Memorandum of Understanding on LHC – approved Jun98, revised Dec99, by M. Krebs (DOE), and R. Eisenstein (NSF).
3. U.S. LHC Project Execution Plan – rev1 approved Oct02, rev0 approved Dec98, by J. O’Fallon (DOE), and J. Lightbody (NSF).
4. U.S. CMS Project Management Plan – approved Nov98, revised Dec02, revised Feb03 by J. O’Fallon (DOE), and J. Lightbody (NSF).

Alternate Cost Status Report (earned value) as of December 31, 2004 (\$K)

WBS Item	Contractor ⁴	Task Description	Cumulative to Date			At Completion		
			BCWS	BCWP	ACWP	Budget	Contractor Estimate	Proj Manager Estimate
1.1		Endcap Muon	39,959	38,401	39,049	41,099	41,328	41,328
1.2		Hadron Calorimeter	43,602	41,066	40,186	43,680	43,617	43,617
1.3		Trigger & Data Acquisition	11,190	10,447	10,689	14,834	15,022	15,022
1.4		Electromagnetic Calorimeter	12,753	12,050	9,536	13,365	13,117	13,117
1.5		Forward Pixels	6,411	4,472	5,030	8,614	8,807	8,807
1.6		Common Projects	23,317	23,321	23,304	23,349	23,309	23,309
1.7		Project Office	6,749	7,291	6,258	7,012	6,738	6,738
1.8		Silicon Tracker	4,311	3,074	3,214	6,186	6,230	6,230
		Contingency				9,109	9,080	9,080
		U.S. Total Project Cost	148,294	140,123	137,268	167,250	167,250	167,250

Change Control Activity (10/04 – 12/04)

<u>Baseline Control Level</u>	<u>Change Control Authority</u>	<u># of Changes</u>
Level 0	DOE –Dir Office of Science/NSF-Assoc Dir for Mathematical and Physical Sciences	Zero
Level 1	DOE/NSF Joint Oversight Group	Zero
Level 2	DOE/NSF Project Office	Four
Level 3	U.S. CMS Project Office	Five

Of the change requests approved for this quarter, 7 affected budget, 2 affected schedule, and 0 affected scope.

⁴ Fermilab is the Host Laboratory for the U.S. CMS Project. In addition to Fermilab, 38 universities participate in the U.S. CMS Project.

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Report Date Feb. 1, 2005	U. S. DOE Project Director's Progress Report	Office of Science
Project Number: n/a	Title: U.S. LHC Construction Project	Program: High Energy Physics
Report Period 1 st Quarter	Project: U.S. ATLAS	Project Office: CH Fermi Area Office

SUMMARY ASSESSMENT

	<u>Current Quarter</u>	<u>Previous Quarter</u>
Cost:	Satisfactory	Satisfactory
Schedule:	Satisfactory	Satisfactory
Technical:	Satisfactory	Satisfactory
Overall:	Satisfactory	Satisfactory

PROJECT MANAGEMENT

DOE Program Manager:	Tom Ferbel	Phone: (301) 903-4115
DOE Federal Project Director:	Pepin Carolan	Phone: (630) 840-2227
Contractor Project Manager:	Bill Willis	Phone: (914)-591-2809

FUNDING (\$K)

	<u>Baseline</u>	<u>Current Est.</u>	<u>Funding⁵</u>
DOE TPC	102,950	102,950	92,341
NON DOE ⁶	60,800	60,800	60,800
Total	163,750	163,750	153,141

CRITICAL DECISIONS

<u>Number</u>	<u>Title</u>	<u>Baseline</u>	<u>Actual/Forecast</u>
CD-1	Approve Mission Need	12/97	12/97 (A)
CD-2	Approve Baselines	03/98	03/98 (A)
CD-3	Start Construction	12/97	12/97 (A)
CD-4A	97% Construction Complete	09/05	09/05 (F)
CD-4B ⁷	100% Construction Complete	09/08	09/08 (F)

FUNDING PROFILE/COSTS

Per FY 2005 budget (\$M)

	<u>Prior</u>	<u>FY03</u>	<u>FY 04</u>	<u>FY 05</u>	<u>FY06</u>	<u>FY07</u>	<u>FY08</u>	<u>Total</u>
DOE TPC	65.94	17.42	8.99	5.49	3.24	1.88	0.0	102.95
NSF	53.51	7.29	0.00	0.00	0.00	0.00	0.0	60.80
Total	119.45	24.71	8.99	5.49	3.24	1.88	0.0	163.75

Cumulative through 12/31/04 (\$K)

Remaining Contingency	10,848
Contingency/Remaining Costs ⁸	76%
Costs Accrued	138,550
Open Commitments	1,604

⁵ Funding is shown through FY03, based on budget request; actual allocation is as provided under Continuing Resolution.

⁶ National Science Foundation (NSF)

⁷ US LHC Level 1 Baseline Change Proposal (USLHC BCP-001), established a two-phased CD-4 milestone. CD-4A = 97% complete. CD-4B remaining 3% of US commitments complete which are dependent upon the startup of the LHC. Funding profile is extended through FY07. No change in US LHC TPC.

⁸ Percentage calculation: Remaining Contingency divided by Remaining Costs where Remaining Costs = Budget at Completion - Actual Cost of Work Performed.

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SCHEDULE SUMMARY

<u>Milestones Accomplished Since Last Report</u>	<u>Baseline Date</u>	<u>Actual Date</u>
<hr/>		
<u>Key Milestones Upcoming (Next Three Months)</u>	<u>Baseline Date</u>	<u>Forecast Date</u>
• Silicon ROD Testing Production/Testing Complete	06/04	03/05
• Muon Kinematic Mounts/Struts Production Complete	11/04	07/05
• TRT Barrel Construction Complete	01/05	05/05
• LAr FCAL-A Delivered to EC	02/05	02/05
• Muon Align System Final Delivery	03/05	06/05

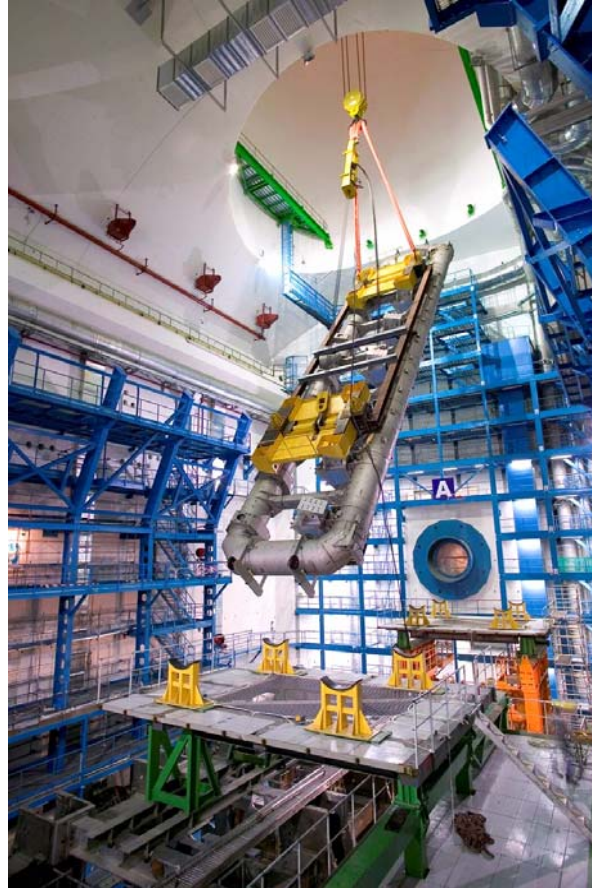
NARRATIVE HIGHLIGHTS

As of December 31, 2004 the project is 93% complete out of 94% planned, reflecting the most recent update of cost and schedule estimates (Estimate-To-Complete '04) for the remaining work to complete the baseline scope. There are no major technical issues- all U.S. ATLAS subsystems are now in production and detector components are being successfully delivered to CERN. Cost and Schedule performance is very good. Contingency planning, prioritization and allocation strategies are focused on ensuring that adequate contingency levels can be maintained through project completion. The current U.S. ATLAS schedule meets ATLAS needs. Forecast dates above have been revised to reflect the latest schedule estimates. Below are a few highlights of the U.S. ATLAS construction project:

- **Silicon:** All sensor work for the Pixels is complete. The delivery rate of bare modules continues to be slower than planned and efforts are underway to seek improvement. Deliverables of Silicon Strips have been shipped and retested. The user evaluation of the ROD is complete. No major defects have been detected. Production of the final ROD has been started.
- **TRT:** Work related to module installation continues at a rapid pace. All Types 1 and 2, and most of type 3, have been installed. All installation modules have been tested for gas leaks, flushing gas leaks, and HV operation. Production for the TRT electronics continues. Orders are underway for all of the End Cap boards and all the Barrel boards.
- **Liquid Argon:** The Liquid Argon Barrel cryostat was lowered into the Cavern. The assembly of the Tile calorimeter modules around the Liquid Argon barrel cryostat has been completed. Preparations are underway for a new FEB pre-production series to be submitted in January of 2005. Full production of FEBs will start one month later. The final assembly of the FCalA was completed and is now ready for insertion into the cryostat. The production of the Level 1 Trigger continues.
- **Tile:** The U.S. ATLAS staff was part of the CERN Tile engineering team who monitored the barrel geometry as modules were mounted. They also assisted on the installation of the barrel cryostat on the Tile barrel calorimeter. Work also continued on the development of the movement system (work being done in collaboration with ATLAS Technical Coordination).

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- **Muon:** The MDT integration and commissioning work continued at CERN with 180 chambers integrated and tested with cosmic rays. All chambers are planned to be integrated by May 2005. Progress continues regarding the MDT electronics. The Mezzanine and Hedgehog card production is complete. Good progress was made on the CSM design and testing for the MDT readout. Progress also continues on the CSC electronics. The ASM2 contract has been released and the first article is expected early next year.
- **TriggerDAQ:** Activity in the ATLAS Combined Test Beam Run continued. HLT tracking algorithms and Muon algorithms were integrated in the combined data taking partition. Preparations were made for the Regular-of-Interest Builder Final Design Review and Production Readiness Review, which are planned for early next year.



Above: A view of the ATLAS Cavern in December 2005. Two Barrel Toroid coils have been installed. The Barrel Tile Calorimeter has been completed surrounding the Liquid Argon Barrel Cryostat.

Far Left: The Barrel Liquid Argon Cryostat being lowered into the ATLAS Cavern in October 2005.

Middle: One of eight ATLAS Barrel Toroid coils being lowered into the ATLAS Cavern in October 2005.

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BACKUP INFORMATION

Baseline Documents

1. U.S. - CERN Agreement and the Accelerator and Experiments Protocols - approved 12/97 by DOE Secretary and NSF Director.
2. DOE/NSF Memorandum of Understanding on LHC, approved 6/98, revised 12/99, by M. Krebs, DOE, and R. Eisenstein, NSF.
3. U.S. LHC Project Execution Plan - approved 12/98 by J. O'Fallon, DOE, and J. Lightbody, NSF.
4. U.S. ATLAS Project Management Plan - approved 3/98, revised 12/99, by J. O'Fallon, DOE, and J. Lightbody, NSF.

Alternate Cost Status Report (earned value) as of Dec. 31, 2004 (\$K)

WBS Item	Contractor ⁹	Task Description	Cumulative to Date			At Completion		
			BCWS	BCWP	ACWP	Budget	Contractor Estimate	Project Mgr. Estimate
1.1		Silicon System	22,288	21,562	21,857	22,554	22,554	22,554
1.2		Transition Radiation Tracker	11,607	11,559	10,790	11,737	11,737	11,737
1.3		Liquid Argon Calorimeter	45,025	44,946	40,225	47,059	47,059	47,059
1.4		Tile Calorimeter	11,200	11,200	11,086	11,221	11,221	11,221
1.5		Muon Spectrometer	28,458	27,526	28,342	28,572	28,572	28,572
1.6		Trigger/Data Acquisition System	3,784	3,784	3,784	8,207	8,207	8,207
1.7		Common Projects	10,947	10,947	10,947	11,979	11,979	11,979
1.8		Education	178	178	178	286	286	286
1.9		Project Management	8,189	8,189	8,189	8,279	8,279	8,279
1.10		Technical Coordination	3,151	3,151	3,151	3,008	3,008	3,008
		Contingency				10,848	10,848	10,848
		Items Outside the Baseline						
		U.S. ATLAS Total	144,827	143,082	138,550	163,750	163,750	163,750

⁹ Brookhaven National Laboratory is the host lab for the U.S. ATLAS Project; there are 30 universities and 3 national laboratories participating in the project.

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Change Control Activity (10/04 – 12/04)

<u>Baseline Control Level</u>	<u>Change Control Authority</u>	<u># of Changes</u>
Level 0	DOE – Director, Office of Science/NSF –Associate Director for Mathematical and Physical Sciences	None
Level 1	DOE/NSF Joint Oversight Group	None
Level 2	DOE/NSF Project Office	None
Level 3	BNL Associate Director for High Energy and Nuclear Physics/U.S. ATLAS Project Office	None

There were no BCPs approved this quarter.

QUARTERLY REPORT FORM

Report Date: 31 January 2005	U. S. DOE Project Manager's Progress Report	Office of Science
Project Number: n/a	Title: U.S. LHC Construction Project	Program: High Energy Physics
Report Period: 1 st Quarter FY2005	Project: U.S. LHC Accelerator	Project Office: CH Fermi Area Office

SUMMARY ASSESSMENT

	<u>Current Quarter</u>	<u>Previous Quarter</u>
Cost:	Minor Concern	Minor Concern
Schedule:	Minor Concern	Satisfactory
Technical:	Satisfactory	Satisfactory
Overall:	Satisfactory	Satisfactory

PROJECT MANAGEMENT

DOE Program Managers:	Tom Ferbel	Phone: 301-903-4115
	Bruce Strauss	Phone: 301-903-3705
DOE Project Manager:	Pepin Carolan	Phone: 630-840-2227
Contractor Manager:	Jim Kerby	Phone: 630-840-3595

FUNDING (\$K)

	<u>Baseline</u>	<u>Current Est.</u>	<u>Funding</u>
DOE TPC	110,000	110,000	108,789
NON DOE	0	0	0
Total	110,000	110,000	108,789

CRITICAL DECISIONS

<u>Number</u>	<u>Title</u>	<u>Baseline</u>	<u>Actual/Forecast</u>
CD-1	Approve Mission Need	12/97	12/97 (A)
CD-2	Approve Baselines	10/98	10/98 (A)
CD-3	Start Construction	12/97	12/97 (A)
CD-4	Construction Complete	09/05	09/05 (F)

FUNDING PROFILE/COSTS

Per FY 2003 Budget (\$M)

	<u>Prior</u>	<u>FY 04</u>	<u>FY 05</u>	<u>Total</u>
DOE TPC	100.95	6.13	2.92	110.00
CERN	49.06	23.2	17.74	90.00
Direct ¹¹				
Total	150.01	29.33	20.66	200.00

Cumulative through 12/31/04 (\$K)

Remaining Contingency	1,211
Contingency/Remaining Costs ¹⁰	41%
Costs Accrued	107,475
Open Commitments	0

¹⁰ Percentage calculation: Remaining Contingency divided by Remaining Costs where Remaining Costs = Budget at Completion - Budgeted Cost of Work Performed.

¹¹ U.S. contributions to the LHC machine includes the \$110 million for the U.S. LHC Accelerator Project and \$90 million for CERN purchases from U.S. industrial suppliers.

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SCHEDULE SUMMARY

<u>Milestones Accomplished Since Last Report</u>	<u>Baseline Date</u>	<u>Actual Date</u>
• First Q3 successfully tested	Mar 04	Dec 04

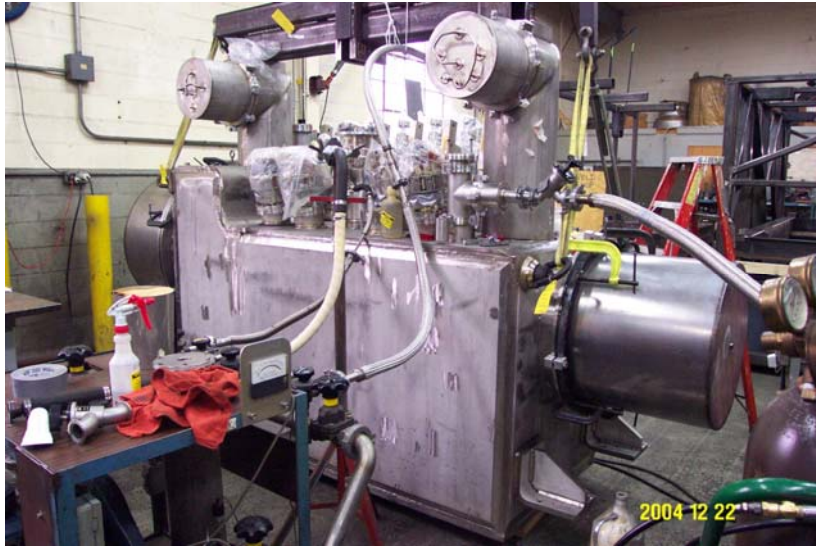
<u>Key Milestones Upcoming (Next Three Months)</u>	<u>Baseline Date</u>	<u>Forecast Date</u>
• First DFBX shipped to CERN	June 04	Jan 05
• First Q3 ready to ship to CERN	August 04	Jan 05

NARRATIVE HIGHLIGHTS

As of December 31, 2004, the overall project was 97% complete versus the scheduled plan of 98% complete. Overall technical progress remains good with all major items in production. Contingency based on the EAC continues to be reduced to address engineering change requests, and this remains a concern that is being closely monitored and carefully managed by the project. The schedule of deliverables is slightly behind plans, but in advance of CERN requirements. Project highlights are listed below:

- [Fermilab] Four of nine Q1 quadrupoles (contain KEK cold masses) and three of nine Q2 quadrupoles have been shipped to CERN. The first Q3 quadrupole (contains a KEK cold mass) was assembled and successfully cold tested. A completed Q2 is ready to be moved to the test stand. The second Q3 quadrupole is being assembled.
- [BNL] All of the D1 dipoles are at CERN. Seven of nine D2 dipoles are at CERN. The last two are still at BNL currently undergoing some rework on the positions of the QQS cryogenic pipe ends and vacuum flanges. All of the D3 dipoles have been assembled. The first D3 has been successfully tested and the second is on the test stand. One of three D4 dipoles is at CERN. The other two are ready to ship. Superconducting cable testing was down to 130 samples this quarter. Approximately 60 samples remain to be tested next quarter after which the testing of LHC samples will be terminated.
- [LBNL] The first of eight cryogenic feedboxes was completed. The second feedbox is nearly completed and both will be shipped to CERN early next quarter. Arrival at CERN is forecasted to be in time for a trial fit-up of the inner triplet on the surface but still well in advance of installation. Assembly of the third and fourth feedboxes has begun. Assembly is moving more rapidly due to experience gained on the first two units.

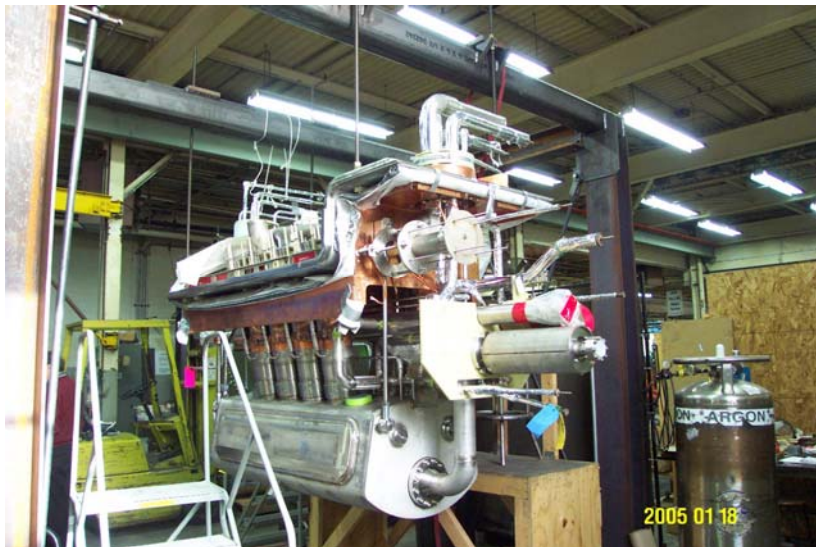
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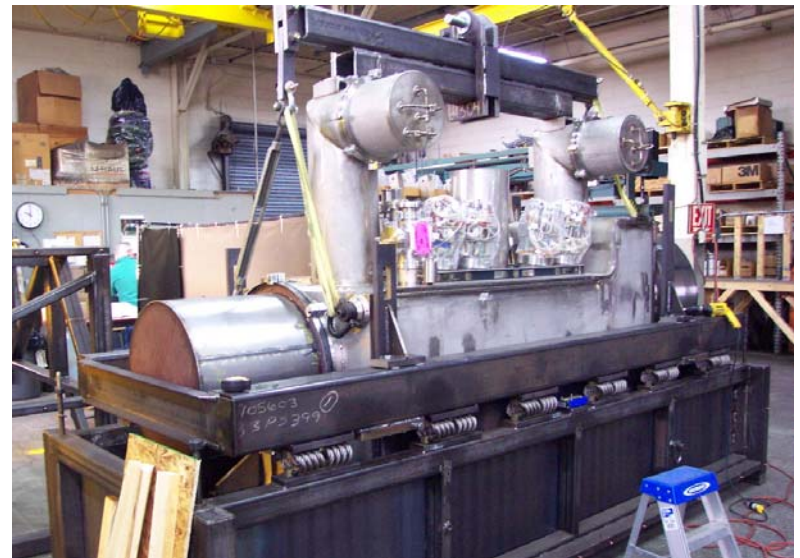
Above – First feedbox, DFBXG, undergoing leak check before final preparation for shipping.



Above – Second feedbox (DFBXD) with vacuum sides being welded.



Above – Third feedbox (DFBXE) on assembly stand. Helium vessel, piping, and current leads have been installed.



Above – DFBXD in shipping frame for transport to CERN.

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BACKUP INFORMATION

Baseline Documents

1. U.S. - CERN Agreement and the Accelerator and Experiments Protocols - approved 12/97 by the DOE Secretary and NSF Director.
2. DOE/NSF Memorandum of Understanding on LHC, approved 6/98, revised 12/99, by M. Krebs, DOE, and R. Eisenstein, NSF.
3. U.S. LHC Project Execution Plan - rev1 approved 10/02, rev0 approved 12/98 by J. O'Fallon, DOE, and J. Lightbody, NSF.
4. U.S. LHC Accelerator Project Management Plan - approved 10/98, by J. O'Fallon, DOE, and J. Lightbody, NSF.

Alternate Cost Status Report (earned value) as of December 31, 2004 (\$K)

WBS Item	Contractor ¹³	Task Description	Cumulative to Date			Budget	At Completion ¹²	
			BCWS	BCWP	ACWP		Contractor Estimate	Project Mgr. Estimate
1.1		Interaction Region Components	63,173	62,333	62,717	64,475	64,475	64,475
1.2		RF Straight Section	15,815	15,679	15,046	15,854	15,854	15,854
1.3		Superconducting Wire and Cable	11,471	11,470	11,094	11,912	11,912	11,912
1.4		Accelerator Physics	3,359	3,359	3,288	3,359	3,359	3,359
1.5		Project Management	13,037	12,990	15,330	13,189	13,189	13,189
		Contingency				1,211	1,211	1,211
		U.S. LHC Accelerator Total	106,855	105,831	107,475	110,000	110,000	110,000

Change Control Activity (10/01/04 – 12/31/04)

<u>Baseline Control Level</u>	<u>Change Control Authority</u>	<u># of Changes</u>
Level 0	DOE - Director, Office of Science/NSF -Associate Director for Mathematical and Physical Sciences	None
Level 1	DOE/NSF Joint Oversight Group	None
Level 2	DOE/NSF Project Office	Two
Level 3	U.S. LHC Accelerator Project Office	None

Two change requests were approved this quarter, both affecting cost, and within available contingency and not affecting schedule requirements.

¹² At completion estimates for the WBS Level 2 elements include G&A and overhead charges for the three laboratories. These costs are tracked separately.

¹³ The U.S. LHC Accelerator Project includes Fermilab, Brookhaven National Laboratory, and Lawrence Berkeley National Laboratory. Fermilab is the lead laboratory.